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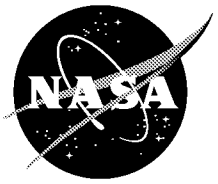

Technical Report Series on the Boreal Ecosystem-Atmosphere Study (BOREAS)

Forrest G. Hall, Editor

Volume 110

CanSIS Regional Soils Data in Vector Format

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CanSIS Regional Soils Data in Vector Format

Bryan Monette, David Knapp

Summary

This data set is the original vector data set received from CanSIS. The data include the provinces of Saskatchewan and Manitoba. Attribute tables provide the various soil data for the polygons; there is one attribute table for Saskatchewan and one for Manitoba. The data are stored in ARC/INFO export format files.

Based on agreements made with Agriculture Canada, these data are available only to individuals and groups that have an official relationship with the BOREAS project. These data are not included on the BOREAS CD-ROM set. A raster version of this data set titled 'BOREAS Regional Soils Data in Raster Format and AEAC Projection' is publicly available and is included on the BOREAS CD-ROM set. See Section 15 for current details on data availability.

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1. Data Set Overview

1.1 Data Set Identification

CanSIS Regional Soils Data in Vector Format

1.2 Data Set Introduction

The Inventory Section of the Land Resource Research Centre (LRRC) undertook an effort to compile a computerized data base to record the attributes of the soil and land for all of Canada and to prepare maps from this information at a scale of 1:1,000,000. The compilation was done by standard methods, and the maps were divided into unit areas called polygons. Each polygon is described in terms of a standard set of attributes that are the factors considered most important for plant growth, general land management, regional planning, terrain sensitivity, and environmental sustainability. The array of attributes that describe a distinct type of soil and its associated characteristics, such as

landform, slope, water table, permafrost, and lakes, is called a soil landscape. A polygon may contain one or two distinctive soil landscapes, as well as small but contrasting inclusions. These vector data from LRRC served as the basis for this raster format data product The original manual documents the standard methods and descriptors used by all provinces for compilation of a national soil landscape data base at a scale of 1:1,000,000.

1.3 Objective/Purpose

These vector format soils data are provided as part of the BOReal Ecosystem-Atmosphere Study (BOREAS) Staff Science Geographic Information System (GIS) Data Collection Program, which included the collection of pertinent map data in both hardcopy and digital form. These vector data were originally distributed by Agriculture Canada to BOREAS Information System (BORIS) staff, and are in ARC/INFO EXPORT format. This data product may be useful to someone who is interested in studying this area at a regional scale. The various soil properties that are included in this data set could also be used for some modeling along with satellite imagery at a similar scale.

1.4 Summary of Parameters

The parameters contained in the various files of the vector soil data include:

Provincial Code
Polygon Number
Kind of Rock Outcrop or other material at the surface
Percentage distribution of dominant and subdominant soil landscapes
Grid code for locating polygons
Regional landform
Local surface form
Slope gradient class
Parent material mode of deposition (or origin)
Parent material texture
Soil development
Surface texture of mineral soil to 15 cm
Coarse fragment content in control section of mineral soils
Rooting depth, unrestricted
Kind of compacted, consolidated, or contrasting layer
Depth to compacted, consolidated, or contrasting layer
Drainage class
Available water capacity in upper 120 cm
Depth to water table, average
Ice type
Ice content
Permafrost occurrence
Active layer depth in soils with permafrost
Kind of patterned ground in soils with permafrost
pH of upper 15 cm of soil ($CaCl_2$)
pH of upper 15 cm of soil (water)
Organic carbon of upper 15 cm
Nitrogen content of upper 15 cm of soil
Thickness of humus layer
Calcareous class of parent material
Inclusions 1
Inclusions 2
Vegetative cover and/or land use
Lake size from Landsat
Water bodies from Landsat as percentage of polygon
Reliability class of polygon

Complexity class of polygon
Soil name 1
Soil name 2
Parent material textural group
Area of Polygon (kilohectares)

1.5 Discussion

The documentation for the original data listed the following uses for which these data were intended:

- Assess the productivity of the land nationally or over large regions.
- Find areas that have actual or potential problems affecting land use, such as salinity or susceptibility to erosion, and assess the severity of the problems.
- Locate general areas that may be suitable for particular types of land use that can be selected for more detailed investigations.
- Apply general research findings and agrotechnology procedures that are successful in one part of the country to other areas that have similar attributes.
- Link soil and land information with other data bases, such as information on climate, economics, or census, for assessing land use on a regional, national, or even an international scale.
- Educate geography students at colleges or universities.

The framework for the legend development, map compilation, and attribute characterization is established by the following concepts and definitions:

- The maps are composed of map delineations called polygons, each of which is described in terms of a standard set of attributes.
- The full array of polygon attributes that describe a distinct type of soil and its associated landscape attributes, such as surface form, slope, water table, permafrost, and lakes, is called a soil landscape.
- A polygon may contain one or two distinctive soil landscapes (dominant or subdominant) and may also contain a small but contrasting proportion of inclusions.
- The dominant (or most prominent) soil landscape represents at least 40% of the polygon area, whereas the subdominant soil landscape represents only from 16 to <40% of the polygon; inclusions represent a maximum of 15% of the polygon. A more detailed description of the complex map polygons is given in Section 7.3.2.
- One or two inclusions can be recorded for each dominant and subdominant soil landscape, but in total they represent a maximum of only 15% of the polygon area.
- The attributes that separate one polygon from another include (a) soil development, (b) soil parent material mode of deposition, (c) texture class of parent material, (d) local surface form, (e) slope gradient class in percent, (f) kind of rock or surface material except water, and (g) spatial occurrence of these attributes within a polygon. These attributes may apply to either the dominant or the subdominant soil landscape.
- The minimum size of the soil landscape area (or polygon) should be about 1 cm x 1 cm at the 1:1,000,000 scale (100 km^2); however, smaller, isolated areas that can be conveniently displayed and labeled on the map are permitted when needed.

1.6 Related Data Sets

BOREAS Regional Soils Data in Raster Format and AEAC Projection
Agriculture Canada Central Saskatchewan Vector Soils Data
BOREAS Soils Data over the SSA in Raster Format and AEAC Projection

2. Investigator(s)

2.1 Investigator(s) Name and Title

BOREAS Staff Science

2.2 Title of Investigation

BOREAS Staff Science GIS Data Collection Program

2.3 Contact Information

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3. Theory of Measurements

The Inventory Section of the LRRC compiled a computerized data base to record the attributes of the soil and land for all of Canada and to prepare maps from this information at a scale of 1:1,000,000. The compilation was done by standard methods, and the maps were divided into unit areas called polygons. Each polygon is described in terms of a standard set of attributes. These attributes are the factors considered most important for plant growth, general land management, regional planning, terrain sensitivity, and environmental sustainability. The array of attributes that describe a distinct type of soil and its associated characteristics, such as landform, slope, water table, permafrost, and lakes, is called a soil landscape. A polygon may contain one or two distinctive soil landscapes, as well as small but contrasting inclusions.

The original uses for which these data were intended include:

- Assess the productivity of the land nationally or over large regions.
- Find areas that have actual or potential problems affecting land use, such as salinity or susceptibility to erosion, and assess the severity of those problems.
- Locate general areas that may be suitable for particular types of land use that can be selected for more detailed investigations.
- Apply general research findings and agrotechnology procedures that are successful in one part of the country to other areas that have similar attributes.
- Link soil and land information with other data bases, such as information on climate, economics, or census, for assessing land use on a regional, national, or even an international scale.
- Educate geography students at colleges or universities.

4. Equipment

4.1 Sensor/Instrument Description

The original vector data were compiled by interpreting Landsat images, conducting aircraft and field traverses, and digitizing the compiled maps. The exact equipment and related specifications are unknown.

4.1.1 Collection Environment

Unknown.

4.1.2 Source/Platform

Unknown.

4.1.3 Source/Platform Mission Objectives

Unknown.

4.1.4 Key Variables

The key variables that are in this raster data set include:

Provincial Code
Polygon Number
Kind of Rock Outcrop or other material at the surface
Percentage distribution of dominant and subdominant soil landscapes
Grid code for locating polygons
Regional landform
Local surface form
Slope gradient class
Parent material mode of deposition (or origin)
Parent material texture
Soil development
Surface texture of mineral soil to 15 cm
Coarse fragment content in control section of mineral soils
Rooting depth, unrestricted
Kind of compacted, consolidated, or contrasting layer
Depth to compacted, consolidated, or contrasting layer
Drainage class
Available water capacity in upper 120 cm
Depth to water table, average
Ice type
Ice content
Permafrost occurrence
Active layer depth in soils with permafrost
Kind of patterned ground in soils with permafrost
pH of upper 15 cm of soil ($CaCl_2$)
pH of upper 15 cm of soil (water)
Organic carbon of upper 15 cm
Nitrogen content of upper 15 cm of soil
Thickness of humus layer
Calcareous class of parent material
Inclusions 1
Inclusions 2
Vegetative cover and/or land use
Lake size from Landsat
Water bodies from Landsat as percentage of polygon

Reliability class of polygon
Complexity class of polygon
Soil name 1
Soil name 2
Parent material textural group
Area of Polygon (kilohectares)

4.1.5 Principles of Operation
Unknown.

4.1.6 Sensor/Instrument Measurement Geometry
Unknown.

4.1.7 Manufacturer of Sensor/Instrument
Unknown.

4.2 Calibration

4.2.1 Specifications
Unknown.

4.2.1.1 Tolerance
Unknown.

4.2.2 Frequency of Calibration
Unknown.

4.2.3 Other Calibration Information
Unknown.

5. Data Acquisition Methods

The original vector soils data were compiled using various data sources and techniques. The data sources and techniques included:

- Interpretation of Landsat images (it is unknown whether the Landsat images were from the Multispectral Scanner (MSS) or Thematic Mapper (TM) instruments).
- Soil survey maps produced from field traverses at wide intervals (up to 10 km) and without the use of aerial photographs.
- Maps produced by inspections using fixed-wing aircraft or helicopter and aided by interpretation of Landsat imagery.
- Systematic traverses by helicopter and interpretation of stereoscopic aerial photographs.
- Modern soil survey procedures, which include traversing existing accessible roads in wilderness areas, and aided by interpretation of stereoscopic aerial photographs.
- Modern soil survey maps produced from field traverses at <1.6-km intervals and with the aid of stereoscopic aerial photographs.

The original data were acquired in ARC/INFO EXPORT format in a vector form. The dominant and subdominant attributes were included in a separate table that was linked to the digital map data by the polygon number.

6. Observations

6.1 Data Notes

The original vector data are documented fully in:

Soil Landscapes of Canada Procedures Manual and User's Handbook J.A. Shields, C. Tarnocai, K.W.G. Valentine, and K.B. MacDonald Land Resource Research Centre Ottawa, Ontario Canada

6.2 Field Notes

Notes are based on information derived from reading:

Soil Landscapes of Canada Procedures Manual and User's Handbook J.A. Shields, C. Tarnocai, K.W.G. Valentine, and K.B. MacDonald Land Resource Research Centre Ottawa, Ontario

BORIS personnel assume that extensive field notes exist from compiling the soils information into maps. The details of these notes are unknown.

7. Data Description

7.1 Spatial Characteristics

The original data were digitized from maps at a scale of 1:1,000,000. The cell size at which these data were gridded is 1,000 meters on a side. There are 41 attributes or "items" that describe the dominant soil characteristics and 40 of the same attributes for the subdominant ones.

7.1.1 Spatial Coverage

There are separate data files for Saskatchewan and Manitoba. The data for Saskatchewan cover the entire province with the following approximate map corners:

	Longitude	Latitude
Northwest	110.000W	60.000N
Northeast	102.000W	60.000N
Southeast	102.000W	49.000N
Southwest	110.000W	49.000N

The data for Manitoba cover the entire province with the following approximate map corners:

	Longitude	Latitude
Northwest	102.000W	60.000N
Northeast	89.000W	60.000N
Southeast	89.000W	49.000N
Southwest	102.000W	49.000N

7.1.2 Spatial Coverage Map

Not available.

7.1.3 Spatial Resolution

These vector data were mapped at a scale of 1:1,000,000. Therefore, the vector polygons are only of sufficient detail to describe the soil properties at that scale.

7.1.4 Projection

The vector data for both Manitoba and Saskatchewan are provided in the Lambert Conformal Conic (LCC) projection. However, the projection parameters for each province are different.

For Manitoba, the following projection parameters were used:

```
Datum: North American Datum of 1927 (NAD27)
Ellipsoid: Clarke 1866
Origin: 98.000°W 0.000°N
Standard Parallels: 50°N 50' 00"
                    58°N 10' 00"
Units of Measure: meters
```

For Saskatchewan, the following projection parameters were used:

```
Datum: NAD27
Ellipsoid: Clarke 1866
Origin: 105.5958333°W 0.000°N
Standard Parallels: 50°N 50' 00"
                    58°N 10' 00"
Units of Measure: meters
```

7.1.5 Grid Description

Not applicable.

7.2 Temporal Characteristics

7.2.1 Temporal Coverage

The booklet that describes the original vector data set was published in 1991:

Soil Landscapes of Canada
Procedures Manual and User's Handbook
J.A. Shields, C. Tarnocai, K.W.G. Valentine, and K.B. MacDonald
Land Resource Research Centre
Ottawa, Ontario
Canada

7.2.2 Temporal Coverage Map

Not available.

7.2.3 Temporal Resolution

These data likely represent a compilation of soils information that was completed over a period of several years. BORIS staff views the data set as a single-point reference source that can be used for soil and other studies. BORIS staff is not aware of any updates that have been made to this data set.

7.3 Data Characteristics

The various gridded layers and the codes that describe their characteristics are list under Section 7, Data Description.

7.3.1 Parameter/Variable

```
Provincial Code
Polygon Number
Kind of Rock Outcrop or other material at the surface
Percentage distribution of dominant and subdominant soil landscapes
Grid code for locating polygons
Regional landform
```

Local surface form
Slope gradient class
Parent material mode of deposition (or origin)
Parent material texture
Soil development
Surface texture of mineral soil to 15 cm
Coarse fragment content in control section of mineral soils
Rooting depth, unrestricted
Kind of compacted, consolidated, or contrasting layer
Depth to compacted, consolidated, or contrasting layer
Drainage class
Available water capacity in upper 120 cm
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Active layer depth in soils with permafrost
Kind of patterned ground in soils with permafrost
pH of upper 15 cm of soil ($CaCl_2$)
pH of upper 15 cm of soil (water)
Organic carbon of upper 15 cm
Nitrogen content of upper 15 cm of soil
Thickness of humus layer
Calcareous class of parent material
Inclusions 1
Inclusions 2
Vegetative cover and/or land use
Lake size from Landsat
Water bodies from Landsat as percentage of polygon
Reliability class of polygon
Complexity class of polygon
Soil name 1
Soil name 2
Parent material textural group
Area of Polygon (kilohectares)

7.3.2 Variable Description/Definition

The following information was extracted (with modifications) from:

Soil Landscapes of Canada
Procedures Manual and User's Handbook
J.A. Shields, C. Tarnocai, K.W.G. Valentine, and K.B. MacDonald
Land Resource Research Centre
Ottawa, Ontario

Provincial Code - The value that designates whether the area is geographically located within Saskatchewan or Manitoba. In the provincial code attribute, the following values are used to represent Saskatchewan and Manitoba:

Code	Description
SK	Saskatchewan
MN	Manitoba

Polygon Number - In the original data sets, the series of polygons composing the entire area were numbered 1 to n.

Surface material - The type of material at the top of the soil in the area. In the dominant and subdominant surface material attributes, the following values are used to represent the various groupings:

Code	Description
IC	Ice and Snow.
OR	Organic Soil. Contains >30% organic matter by weight.
R1	Soft rock, undifferentiated. Rock that can be dug with shovel, e.g., shales, Upper Cretaceous, and Tertiary materials.
R2	Hard rock, acidic. Granite.
R3	Hard rock, carbonaceous. Limestone.
R4	Hard rock, undifferentiated. Hard rock of unspecified origin and properties.
SO	Mineral soil. Dominantly mineral particles, contains <30% organic matter by weight.
WA	Water.
UR	Urban areas. Note: Only a few major urban area polygons are shown on maps; do not use for tabulating urban areas.
#	Not applicable.
-	Attribute does not occur.

Percentage distribution of dominant and subdominant soil landscapes - The values in the dominant and subdominant columns represent the percentage of that soil landscape in the area.

Regional landform - The type of landform on which this area exists (e.g., mountain, hill, tableland). In the dominant and subdominant regional landform attributes, the following values are used to represent the various groupings:

Code	Description
B	Tableland (or plateau) dominated. Comparatively flat areas of great extent commonly bounded on at least one side by an abrupt escarpment, or may be terminated by mountains; may be dissected by deep valleys and deeply incised rivers; may be tectonic, erosional, or volcanic in origin; may be step-faulted; slopes generally <10%, in some places 10-15%; relief generally <50 m.
H	Hilland dominated. Natural elevations rising prominently above the surrounding plain and having a recognizably denser pattern of generally higher knolls or crest lines with an irregular or chaotic surface form composed of upper surface convexity and lower concavity; includes hummocky morainal material, volcanic cones, and conical hills of lava; slopes generally 10-30%; relief generally <100 m.
M	Mountain dominated. Erosional and volcanic landscapes with relief (vertical distance between higher and lower parts) >300 m with most of the area comprising valley-to-summit terrain; slopes generally >30%. In general, the terrain has

	a restricted summit area and steep sides, irregular shape and considerable bare rock surface, or very thin soil cover; occurs as a single, isolated feature or in a group forming a long chain or range; major scarps are relatively steep and straight cliff-like slopes of considerable linear extent separating surfaces such as plateaus lying at different levels.
O	Organic wetland dominated. Areas dominated by organic material >40 cm thick; contains >30% organic matter by weight; occurs in a variety of wetland surface forms.
P	Plain dominated. Flat to very gently undulating areas having few or no prominent irregularities; formed by erosional or by depositional (or constructional) processes; includes broad, continuous, gently sloping piedmont plains extending along and from the base of a mountain, formed by lateral coalescence of a series of separate but confluent alluvial fans; alluvial processes are mainly responsible for the sedimentation; coarse fragments are rounded by transport over relatively long distances; slopes generally <6%; relief generally <10 m; extent generally >5 km in one direction.
S	Scarp dominated. An escarpment, cliff, or steep slope of some extent along the margin of a terrace, bench, plateau, hill, or mesa; a scarp may be of any height.
V	Valley dominated. Terrain dominated by major spillways, drainageways, or mountain trenches separated from surrounding landforms by a significant and abrupt break in slope; the valley profile may be V- or U-shaped with an extensive valley floor and flood plain up to about 5 km wide; valley profile may also include eroded terraces and their irregular slope segments.
#	Not applicable. (urban area).
-	Attribute does not occur.

Local surface form - The type of local surface form on which the area is located (e.g., inclined, level, dissected). In the dominant and subdominant local surface form attributes, the following values are used to represent the various groupings:

Code	Description
D	Dissected. A dissected (or gullied) pattern providing external drainage for an area.
H	Hummocky (or irregular). A very complex sequence of slopes extending from somewhat rounded concavities (or swales) or various sizes to irregular, conical knolls (or knobs) and short, discontinuous ridges; there is a general lack of concordance between knolls and swales; slopes are 4-70%; examples: hummocky moraine, hummocky fluvioglacial.
I	Inclined. A sloping, unidirectional surface with a generally constant slope not broken by marked irregularity or gullies; a weakly developed pattern provides external drainage for the local area; slopes are 2-70%; the form of inclined slopes is not related to the initial mode of origin of the underlying material.
K	Knoll and kettle. A very chaotic sequence of knolls and

numerous kettles (or sloughs), which occupy 15-20% of an area and have no external drainage; slopes are generally >3%; examples: morainal plains and hillands.

L Level. A flat-very gently sloping, unidirectional surface with a generally constant slope not broken by marked elevations and depressions; slopes are generally <2% (i.e., 1%); examples: flood plain, lake plain.

M Rolling. A very regular sequence of moderate slopes extending from rounded and, in some places, confined concave depressions to broad, rounded convexities producing a wavelike pattern of moderate relief; slope gradients are generally >5% but may be less; this surface form is usually controlled by the underlying bedrock.

R Ridged. A long, narrow elevation of the surface, usually distinctly crested with steep sides; ridges may be parallel, subparallel, or intersecting; examples: eskers, crevasse fillings, washboard moraines, some drumlins.

S Steep. Erosional slopes >70%, on both consolidated and unconsolidated materials; form of a steep erosional slope on unconsolidated materials is not related to the initial mode of origin of the underlying material; example: escarpments.

T Terraced. Scarp face and the horizontal or gently inclined surface (or tread) above it; example: alluvial terrace.

U Undulating. A very regular sequence of gentle slopes that extends from rounded and, in some places, confined concavities to broad, rounded convexities producing a wavelike pattern of low local relief; slope length is generally <0.8 km and the dominant gradient of slopes is usually 2-5%; it lacks an external drainage pattern; examples: some ground moraine, lacustrine material of varying texture.

BO4 Domed bog. A large (diameter usually >500 m) bog with a convex surface, rising several meters above the surrounding terrain; center usually drains in all directions; small crescentic pools commonly form around the highest point; if the highest point is in the center, the pools form a concentric pattern or, if the highest point is off-center, an eccentric pattern; the peat development is usually >3 m.

BO5 Polygonal peat plateau bog. A perennially frozen bog, rising about 1 m above the surrounding fen, the surface is relatively flat, scored by a polygonal pattern of trenches that developed over ice wedges; the permafrost and ice wedges developed in peat originally deposited in a nonpermafrost environment.

BO7 Peat plateau bog. A bog composed of perennially frozen peat, rising abruptly about 1 m from the surrounding unfrozen fen; the surface is relatively flat and even and commonly covers large areas; the peat was originally deposited in a nonpermafrost environment and is associated in many paces with collapse scar bogs or fens.

BO9 Atlantic plateau bog. A bog with a flat-to-undulating surface raised above the surrounding terrain, with the bog edges commonly sloping steeply down toward the mineral soil terrain; large pools scattered on the bog reach a depth of

B13 Basin bog. A bog situated in a basin that has an essentially closed drainage, receiving water from precipitation and from runoff from the immediate surroundings; the surface of the bog is flat, but the peat is generally deepest at the center.

B14 Flat bog. A bog having a flat, featureless surface and occurring in broad, poorly defined depressions; the depth of peat is generally uniform.

B15 String bog. A pattern of narrow (2-3 m wide), low (<1 m deep) ridges oriented at right angles to the direction of drainage; wet depressions or pools occur between the ridges; the water and peat are very low in nutrients, because the water has been derived from other ombrotrophic wetlands; peat thickness is >1 m.

B16 Blanket bog. A bog consisting of extensive peat deposits that occur more or less uniformly over gently sloping hills and valleys; the peat thickness is usually <2 m.

B18 Slope bog. A bog occurring in areas of high rainfall on appreciably sloping land surfaces, fed by rainwater and by water draining from other nutrient-poor wetlands; the peat may exceed 1 m in thickness.

B19 Veneer bog. A bog occurring on gently sloping terrain underlain by generally discontinuous permafrost; although drainage is predominantly below the surface, overland flow occurs in poorly defined drainageways during peak runoff; peat thickness is usually <1.5 m.

FO1 Northern ribbed fen. A fen with parallel, low peat ridges ("strings") alternating with wet hollows or shallow pools, oriented across the major slope at right angles to water movement; the depth of peat is >1 m.

FO7 Shore fen. A fen with an anchored surface mat that forms the shore of a pond or lake; the rooting zone is affected by the water of the lake at both normal and flood levels.

F11 Slope fen. A fen occurring mainly on slow-drainage, nutrient-enriched seepage slopes; pools are usually absent, but wet seepage tracks may occur; peat thickness is usually <2 m.

F13 Horizontal fen. A fen with a very gently sloping, featureless surface; this fen occupies broad, often ill-defined depressions and may interconnect with other fens; peat accumulation is generally uniform.

SO1 Stream swamp. A swamp occurring along the banks of permanent or semipermanent streams; the high-water table is maintained by the level of water in the stream; the swamp is seasonally inundated, with subsequent sediment deposition.

SO4 Basin swamp. A swamp developed in a topographically defined basin where water derived locally may be augmented by drainage from other parts of the watershed; accumulation of well-decomposed peat is shallow (<0.5 m) at the edge and may reach 2 m at the center.

MO6 Stream marsh. A marsh occupying shorelines, bars, streambeds, or islands in continuously flowing water courses; the marsh is subject to prolonged annual flooding and is commonly covered by thick layers of sediments.

M11	Shallow basin marsh. A marsh occurring in a uniformly shallow depression or swale, having a gradual gradient from the edge to the deepest portion; the marsh edge may be poorly defined; water levels fluctuate rapidly.
M14	Shore marsh. A marsh occupying the contact zone between high and low water marks bordering semipermanent or permanent lakes; the marsh is usually found along protected shorelines, in lagoons behind barrier beaches, on islands, or in embayments; the marsh is subject to flooding by rise in lake levels, wind, waves, or surface runoff.
#	Not applicable (urban area).
-	Attribute does not occur.

Slope gradient class - The slope category of the land surface area. In the dominant and subdominant slope gradient class attributes, the following values are used to represent the various groupings:

Code	Description
A	1-3% (includes slopes <1%)
B	4-9%
C	10-15%
D	16-30%
E	31-60%
F	>60%
#	Not applicable (water)
-	Attribute does not occur

Soil parent material mode of deposition - The mode in which the soil parent material was deposited on the area (e.g., colluvial, eolian, bog). In the dominant and subdominant soil parent material attributes, the following values are used to represent the various groupings:

Code	Description
A	Alluvial. Sediment generally consisting of gravel and sand with a minor fraction of silt and clay; gravels are typically rounded and contain interstitial sand; alluvial sediments are commonly moderately to well sorted and display stratification; examples: channel deposits, overbank deposits, terraces, alluvial fans, and deltas.
B	Bog. Bogs consist of unspecified organic materials associated with an ombrotrophic environment because the slightly elevated nature of the bog dissociates it from nutrient-rich ground water or surrounding mineral soils; near the surface, materials are usually undecomposed (fibric), yellowish to pale brown, loose and spongy in consistence, and entire sphagnum plants are readily identified; these materials are extremely acid, with low bulk density and high fiber content; at depths they become darker, compacted, and somewhat layered; bogs are associated with slopes or depressions on topography with a water table at or near the surface in the spring and slightly below it during the rest of the year; they are usually covered with sphagnum mosses, but sedges may also grow on them; bogs may be treed or treeless and many are characterized by a layer

of ericaceous shrubs.

C Colluvial. Massive to moderately well stratified, nonsorted to poorly sorted sediments with any range of particle sizes from clay to boulders that have reached their present position only by direct, gravity-induced movement (excepting snow avalanches); processes include slow displacements such as creep and solifluction and rapid movements such as Earth flows.

D Residual. Unconsolidated, weathered, or partly weathered soil mineral material that accumulates by disintegration of bedrock in place.

E Eolian. Sediment, generally consisting of medium-to-fine sand and coarse silt particle sizes, that is well sorted, poorly compacted, and may show internal structures such as cross bedding or ripple laminae, or may be massive; individual grains may be rounded and show signs of frosting; these materials have been transported and deposited by wind action; examples: dunes, shallow deposits sand and coarse silt, and loess but not tuffs.

F Fluvioglacial. Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice; deposits are stratified and may occur in the form of outwash plains, deltas, kames, eskers, and kame terraces.

H Marsh. Mineral wetland or wetland that is periodically inundated by standing or slow-moving water; surface water levels may fluctuate seasonally, with declining levels exposing drawdown zones of matted vegetation or mudflats; waters are rich in nutrients, varying from fresh to highly saline; substratum usually consists of mineral material, although in some places it consists of well-decomposed peat; soils are predominantly Gleysols, with some Humisols and Mesisols; marshes characteristically show zonal or mosaic surface patterns composed of pools or channels interspersed with clumps of emergent sedges, grasses, rushes, and reeds, bordering grassy meadows, and peripheral bands of shrubs or trees; submerged and floating aquatics flourish where open-water areas occur.

L Lacustrine. Sediment generally consisting of either stratified fine sand, silt, and clay deposited on the lake bed or moderately well sorted and stratified sand and coarser materials that are beach and other nearshore sediments transported and deposited by wave action; these materials have either settled from suspension in bodies of standing freshwater or accumulated at their margins through wave action; examples: lake sediments and beaches.

M Morainal. Sediment generally consisting of well-compacted material that is nonstratified and contains a heterogeneous mixture of sand, silt, and clay particle sizes and coarse fragments in a mixture that has been transported beneath, beside, on, within, or in front of a glacier and not modified by any intermediate agent; examples: basal till (ground moraines, rubbly moraines of cirque glaciers, hummocky ice-disintegration moraines, and preexisting, unconsolidated sediments reworked by a glacier so that their

original character is largely or completely destroyed.

N Fen. Fen consists of unspecified organic materials formed in a minerotrophic environment because of the close association of the material with mineral-rich waters; it is usually moderately well to well decomposed, dark brown to black, with fine- to medium-sized fibers; decomposition commonly becomes greater at lower depths; the materials are covered with a dominant component of sedges, but grasses and reeds may be associated in local pools.

O Organic, undifferentiated. A layered sequence of more than three types of organic material (>30% organic matter by weight).

R Rock. A consolidated bedrock layer that is too hard to break with the hands (>3 on Mohs' scale) or to dig with a spade when moist.

S Swamp. Minerotrophic wetland with the water table at or above the peat surface; dominant unspecified organic materials are forest and fen peat formed in a eutrophic environment because of strong water movement from the margins or other mineral sources; it is usually moderately well to well decomposed and has a dark brown to reddish brown matrix; the more decomposed materials are black; it has an amorphous or very fine-fibered structure containing a random distribution of woody fragments and trunks of coniferous tree species; the vegetation cover may consist of coniferous or deciduous trees, tall shrubs, herbs, and mosses; in some regions sphagnum mosses are abundant.

T Anthropogenic. Materials modified by people, including those associated with mineral exploitation and waste disposal; they include materials deposited as a result of human activities or geological materials modified artificially so that their physical properties (structure, cohesion, compaction) have been drastically altered; examples: areas of landfill, spoil heaps, open-pit mines, leveled irrigated areas.

U Undifferentiated. A sequence of more than three types of genetic mineral materials outcropping on a steep erosional escarpment; this complex class is to be used where units relating to individual genetic materials cannot be delimited separately at the scale of mapping; it may include colluvium derived from the various genetic materials and resting upon the scarp slope.

V Volcanic. Volcanic pumice and ash.

W Marine. Unconsolidated deposits of clay, silt, sand, or gravel that are well to moderately well sorted and well to moderately well stratified (in some places containing shells); they have settled from suspension in salt or brackish water bodies or have accumulated at their margins through shoreline processes such as wave action and longshore drift; nonfossiliferous deposits may be judged marine, if they are located in an area that might reasonably be considered to have contained saltwater at the time the deposits were formed.

11 Fibric Sphagnum. Sphagnum organic material in a fibric

	degree of decomposition in which the fibric materials are readily identifiable as to botanical origin; peat is usually undecomposed (or fibric), light yellowish brown to pale brown, and loose and spongy in consistency with the entire sphagnum plant being readily identifiable.
21	Mesic sedge. Sedge organic material in a mesic (or intermediate) degree of decomposition; peat composed dominantly of sedge (Carex spp.) and generally moderately decomposed and matted; the sedge leaves are readily identifiable to the naked eye; this material commonly contains large amounts of very fine roots of the above species.
22	Mesic woody sedge. Woody sedge organic material in a mesic (or intermediate) degree of decomposition; peat is composed dominantly of sedge peat (see code 21) with subdominant amounts of woody materials.
23	Mesic woody forest. Woody forest organic material in a mesic (or intermediate) degree of decomposition; peat is composed dominantly (>50%) of woody materials derived from both coniferous and deciduous tree species; in general, wood fragments are easily identifiable in this peat.
25	Mesic sphagnum. Sphagnum organic material in a mesic (or intermediate) degree of decomposition.
31	Humic sedge. Sedge organic material in a humic (or most advanced) degree of decomposition in which most of the material is humified, and there are few recognizable fibers.
#	Not applicable (urban area).
-	Attribute does not occur.

Parent material texture - The texture category to which the parent material was assigned (e.g., very fine sand, sandy loam, clay). In the dominant and subdominant soil parent material texture attributes, the following values are used to represent the various groupings:

Code	Description
CBS	Cobbly sand. 15-35% cobbles by volume.
VGS	Very gravelly sand. 35-60% gravel by volume.
GS	Gravelly sand. 15-35% gravel by volume.
S	Sand.
CS	Coarse sand. 25% or more very coarse and coarse sand.
FS	Fine sand. 50% or more fine sand.
VS	Very fine sand. 50% or more very fine sand.
LFS	Loamy fine sand. 50% or more fine sand.
LVFS	Loamy very fine sand. 50% or more very fine sand.
CBLS	Cobbly loamy sand. 15-35% cobbles by volume.
VGLS	Very gravelly loamy sand. 35-60% gravel by volume.
GLS	Gravelly loamy sand. 15-35% gravel by volume.
LS	Loamy sand.
CBSL	Cobbly sandy loam. 35-60% cobbles by volume.
VGSL	Very gravelly sandy loam. 35-60% gravel by volume.
GSL	Gravelly sandy loam. 15-35% gravel by volume.
SL	Sandy loam.
GFL	Gravelly fine sandy loam. 15-35% gravel by volume.

FL	Fine sandy loam. 30% or more fine sand.
CBL	Cobbly loam. 15-35% cobbles by volume.
GL	Gravelly loam. 15-35% gravel by volume.
L	Loam.
VL	Very fine sandy loam. 30% or more very fine sand.
GSIL	Gravelly silt loam. 15-35% gravel by volume.
SIL	Silt loam.
GSCL	Gravelly sandy clay loam. 15-35% gravel by volume.
SCL	Sandy clay loam.
VCL	Very fine sandy clay loam. 30% or more very fine sand.
CBCL	Cobbly clay loam. 15-35% cobbles by volume.
GCL	Gravelly clay loam. 15-35% gravel by volume.
CL	Clay loam.
SICL	Silty clay loam.
SC	Sandy clay.
C	Clay.
GSIC	Gravelly silty clay. 15-35% gravel by volume.
SIC	Silty clay.
HC	Heavy clay.
#	Not applicable.
-	Attribute does not occur.

Soil development - The category of soil development for the area (e.g., Gray Brown Luvisolic, Eutric Brunisolic). In the dominant and subdominant soil development attributes, the following values are used to represent the various groupings:

Code	Description
A	Brown Chernozemic. Dominantly Orthic Brown subgroup with inclusions of other subgroups within the Brown great group.
B	Dark Brown Chernozemic. Dominantly Orthic Dark Brown subgroup with inclusions of other subgroups within the Dark Brown great group.
C	Black Chernozemic. Dominantly Orthic Black subgroup with inclusions of other subgroups within the Black great group.
D	Dark Gray Chernozemic or Dark Gray Luvisolic. Dominantly Orthic Dark Gray Chernozemic subgroup or Dark Gray Luvisol subgroup with inclusions of other subgroups within the Dark Gray great group or of the gleyed Dark Gray Luvisol subgroup.
E	Gray Brown Luvisolic. Dominantly Orthic Gray Brown Luvisol subgroup with inclusions of other subgroups within the Gray Brown Luvisol great group.
F	Gray Luvisolic. Dominantly Orthic Gray Luvisol subgroup with inclusions of other Gray Luvisol subgroups.
G	Brown Solonetzic. May be dominantly Brown Solonetz or Brown Solodized Solonetz or Brown Wolod subgroup with inclusions of these subgroups, i.e., dominantly Brown Solodized Solonetz with inclusions of Brown Solod.
H	Dark Brown Solonetzic. May be dominantly Dark Brown Solonetz or Dark Brown Solodized Solonetz or Dark Brown Solod subgroup with inclusions of these subgroups.
I	Brunisolic Gray Luvisolic. Dominantly Brunisolic Gray Luvisol subgroup with inclusions of its gleyed subgroup.

J	Black Solonetzic. May be dominantly Black Solonetz or Black Solodized Solonetz or Black Solod subgroup with inclusions of these subgroups and their gleyed subgroups.
K	Gray Solonetzic. Dominantly Gray Solodized Solonetz or Gray Solod subgroups with inclusions of their gleyed subgroups.
L	Melanic Brunisolic. Dominantly Melanic Brunisol great group.
M	Eutric Brunisolic. Dominantly Eutric Brunisol great group.
N	Sombric Brunisolic. Dominantly Sombric Brunisol great group.
O	Organic Cryosolic. Dominantly Organic Cryosol great group.
P	Dystric Brunisolic. Dominantly Dystric Brunisol great group.
Q	Humic Podzolic. Dominantly Humic Podzol great group.
R	Regosolic. Dominantly Regosolic order.
S	Static Cryosolic. Dominantly Static Cryosol great group.
T	Turbic Cryosolic. Dominantly Turbic Cryosol great group.
U	Gleysolic. Dominantly Gleysolic order.
V	Ferro-Humic Podzolic. Dominantly Ferro-Humic Podzol great group.
W	Humo-Ferric Podzolic. Dominantly Humo-Ferric Podzol great group.
X	Fibrisol. Dominantly Fibrisol great group.
Y	Mesisol. Dominantly Mesisol great group.
Z	Humisol. Dominantly Humisol great group.
2	Folisol. Dominantly Folisol great group.
3	Podzolic Gray. Podzolic Gray Luvisol subgroup; only occurs as subdominant.
#	Not applicable. (water, rock, or ice).
-	Attribute does not occur.

Surface texture of mineral soil to 15 cm - The texture of the soil between the surface and a depth of 15 cm. The values and codes shown above for parent material texture also apply to the surface soil texture.

Coarse fragment content of mineral soils - The categorized percent by volume of rounded, subrounded, flat, angular, or irregular rock fragments from 0.2 to 60 cm or more in size. In the dominant and subdominant coarse fragment content attributes, the following values are used to represent the various groupings:

Code	Description
A	<10% by volume. Rounded, subrounded, flat, angular, or irregular rock fragments from 0.2 to 60 cm or more in size.
B	10-30%.
C	31-65%.
D	>65%.
#	Not applicable.
-	Attribute does not occur.

Rooting depth, unrestricted - The unrestricted rooting depth for vegetation that is growing in the area. In the dominant and subdominant rooting depth attributes, the following values are used to represent the various groupings:

Code	Description
0	<20 cm
50	20-75 cm
100	76-150 cm
200	>150 cm
#	Not applicable (e.g., rock, ice)
-	Attribute does not occur

Kind of compacted, consolidated, or contrasting layer - The type of compacted, consolidated, or contrasting layer that is present (e.g., Ortstein, Ortstein). In the dominant and subdominant compacted, consolidated, or contrasting layer attributes, the following values are used to represent the various groupings:

Code	Description
A	Compacted parent material. Compacted glacial till or other material.
B	Basal till. Compacted glacial till deposited beneath a moving glacier.
C	Compacted material (anthropogenic). Soil material compacted by human activities that adversely affect crop production.
D	Duric horizon. This strongly cemented Bc horizon does not satisfy the criteria of a podzolic B horizon; usually it has an abrupt upper boundary to an overlying podzolic B or to a Bm horizon and a diffuse lower boundary >0.5 m below; cementation is usually strongest near the upper boundary and occurs commonly at a depth of 40-80 cm from the mineral surface; the color of the duric horizon usually differs little from that of the moderately coarse textured to coarse textured parent material, and the structure is usually massive or very coarse platy; air-dry clods of duric horizons do not slake when immersed in water, and moist clods >3 cm thick usually cannot be broken in the hands.
E	Ortstein. Horizon of fragipan character; a fragipan is a loamy subsurface horizon of high bulk density and very low organic matter content; when dry, it has a hard consistency and seems to be cemented; when moist, it has moderate to weak brittleness; it commonly has bleached fracture planes and is overlain by a friable B horizon; air-dry clods of fragic horizons slake in water.
O	Ortstein. This strongly cemented Bh, Bhf, or Bf horizon, >3 cm thick, occurs in more than one-third of the exposed face of the pedon; ortstein horizons are generally reddish brown to very dark reddish brown.
P	Placic horizon. This layer (commonly <5 mm thick) or series of thin layers is irregular or involuted, hard, impervious, commonly vitreous, and dark reddish brown to black; placic horizons may be cemented by Fe, Al-organic complexes (Bhfc or Bfc), hydrated Fe oxides (Bgfc), or a mixture of Fe and Mn oxides.
R	Rock. Consolidated bedrock too hard either to break with the hands (>3 on Mohs' scale) or to dig when moist.
G	Gravel. A layer of coarse fragments with diameters of

	0.2-7.5 cm.
L	Colluvium. See attribute number 09, code C.
S	Sand. Soil texture class in which the material contains >85% of sand-sized separate; the percentage of silt plus 1.5 times the percentage of clay does not exceed 15%.
X	Silt. Soil texture class in which the material contains >80% silt and <12% clay.
Y	Clay. Soil texture class in which the material contains >40% clay, <45% sand, and <40% silt-sized separates.
#	Not applicable.
-	Attribute does not occur.

Depth to compacted, consolidated, or contrasting layer - The depth class for any compacted, consolidated, or contrasting layer that exists. In the dominant and subdominant depth to compacted, consolidated, or contrasting layer attributes, the following values are used to represent the various groupings:

Code	Description
1	0-49 cm
2	50-100 cm
3	>100 cm
4	<100 cm for mineral overlays
5	<160 cm for shall (terric) organic
#	Not applicable
-	Attribute does not occur

Drainage class - The drainage class of the soil over the area (e.g., excessive, rapid, poor). In the dominant and subdominant drainage class attributes, the following values are used to represent the various groupings:

Code	Description
E	Excessive. Water is removed from the soil very rapidly in relation to supply; excess water flows downward very rapidly if underlying material is pervious; subsurface flow may be very rapid during heavy rainfall provided the gradient is steep; source of water is precipitation.
R	Rapid. Water is removed from the soil rapidly in relation to supply; excess water flows downward if underlying material is pervious; subsurface flow may occur on steep gradients during heavy rainfall; source of water is precipitation.
W	Well. Water is removed from the soil readily but not rapidly; excess water flows downward readily into underlying pervious material or laterally as subsurface flow; these soils commonly retain optimum amounts of moisture for plant growth after rains or addition of irrigation water.
M	Moderately well. Water is removed from the soil somewhat slowly in relation to supply; excess water is removed somewhat slowly because of low perviousness, shallow water table, lack of gradient, or some combination of these; precipitation is the dominant source of water in medium- to fine-textured soils; precipitation and significant additions

	by subsurface flow are necessary in coarse-textured soils.
I	Imperfect. Water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season; excess water moves slowly downward if precipitation is the major supply; if subsurface water or ground water, or both, is the main source, the flow rate may vary but the soil remains wet for a significant part of the growing season.
P	Poor. Water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time the soil is not frozen; excess water is evident in the soil for much of the time; subsurface flow or ground water flow, or both, in addition to precipitation are the main sources of water; there may also be a perched water table.
V	Very poor. Water is removed from the soil so slowly that the water table remains at or on the surface for most of the time the soil is not frozen; ground water flow and subsurface flow are the major sources of water; precipitation is less important except where there is a perched water table.
#	Not applicable.
-	Attribute does not occur

Available water capacity in upper 120 cm - That portion of water in a soil that can be readily absorbed by plant roots. Most people consider it to be the water held in the soil between field capacity and a pressure of up to about 15 bars. In the dominant and subdominant water capacity attributes, the following values are used to represent the various groupings:

Code	Description
1	50 mm
2	100 mm
3	150 mm
4	200 mm
5	250 mm
6	Not applicable (Solonetzic or saline soils)
7	Not applicable (high water table)
8	Not applicable (perennially frozen subsoils)
#	Not applicable (water, ice, rock)
-	Attribute does not occur

Average Depth to water table - The average depth to the water table in the area. In the dominant and subdominant depth to water table attributes, the following values are used to represent the various groupings:

Code	Description
1	0-2 m Most shallow water table during growing season
2	2-3 m
3	>3 m
4	0-1 m
5	1-2 m
6	0-1 m With perennially frozen subsoil
#	Not applicable (water, ice, rock)
-	Attribute does not occur

Ice type - The type of ice found in the soil. In the dominant and subdominant ice type attributes, the following values are used to represent the various groupings:

Code	Description
1	Ice crystals and ice lenses
2	Ice wedges
3	Massive ground ice
4	Undifferentiated
#	Not applicable
-	Attribute does not occur

Ice content - The relative amount of ice contained in the soil. In the dominant and subdominant ice content attributes, the following values are used to represent the various groupings:

Code	Description
L	Low
M	Medium
H	High
#	Not applicable
-	Attribute does not occur

Permafrost occurrence - The relative occurrence of permafrost in the soil of the area. In the dominant and subdominant permafrost occurrence attributes, the following values are used to represent the various groupings:

Code	Description
V	Very sporadic. Sparse patches of permafrost occurring near the southern limit of permafrost.
S	Sporadic. The occurrence of isolated patches or islands of permafrost near the southern boundary of discontinuous permafrost zone.
D	Discontinuous. Permafrost occurring in some areas beneath the exposed land surface throughout a geographic region where other areas are free of permafrost.
C	Continuous. Permafrost occurring everywhere beneath the exposed land surface throughout a geographic region with the exception of widely scattered sites, such as newly deposited unconsolidated sediments.
#	Not applicable.
-	Attribute does not occur.

Active layer depth in soils with permafrost - The depth of the top layer of ground subject to annual thawing and freezing in areas underlain by permafrost. The value in the attribute represents the depth of the active layer.

Kind of patterned ground in soils with permafrost - The types of geometrically shaped patterns found in soils with permafrost. In the dominant and subdominant kind of patterned ground attributes, the following values are used to represent the various groupings:

Code	Description
01	Sorted circle. Patterned ground having a dominantly circular mesh and a sorted appearance commonly produced by a border of stones surrounding finer material.
02	Sorted net. Patterned ground having a mesh neither dominantly circular nor polygonal; a sorted appearance results from borders of stones surrounding finer material.
03	Sorted stripe. Patterned ground with a striped pattern and sorted appearance resulting from parallel lines of stones and intervening stripes of finer material oriented down the steepest available slope.
04	Sorted large polygon. Patterned ground having a dominantly polygonal mesh and a sorted appearance commonly produced by border of stones surrounding finer material; polygon diameter is >1 m.
05	Sorted small polygon. Same for code 04 except that polygon diameter is <1 m.
06	Nonsorted circle. Patterned ground having a dominantly circular mesh but lacking a border of stones.
07	Nonsorted net. Patterned ground having neither a dominantly circular or polygonal mesh nor a border of stones.
08	Nonsorted large polygon. Patterned ground having a dominantly polygonal mesh but lacking a border of stones; polygon diameter is >1 m.
09	Nonsorted small polygon. Same for code 08 except that polygon diameter is <1 m.
10	Earth hummock. Hummock having a core of silty and clayey mineral soil and showing signs of cryoturbation.
11	Lowland (peat) polygon. Bog with flat-topped or convex peat surfaces separated by trenches over ice wedges that form a polygonal pattern at the surface.
12	Polygonal peat plateau. Generally flat-topped expanse of peat elevated above the general surface of a wetland and containing segregated ice that may or may not extend downward into underlying mineral soil.
13	No pattern. Unpatterned ground.
#	Not applicable.
-	Attribute does not occur.

pH of upper 15 cm of soil measured in $CaCl_2$ - The pH of the upper 15 cm of soil as measured using $CaCl_2$. The value in the attribute divided by 10 represents the pH of the upper 15 cm of soil.

pH of upper 15 cm of soil measured in water - The pH of the upper 15 cm of soil as measured using water. The value in the attribute divided by 10 represents the pH of the upper 15 cm of soil.

Organic carbon of upper 15 cm of soil - The percent of organic carbon contained in the upper 15 cm of soil. The value in the attribute represents the nearest percent of carbon in the top 15 cm of soil.

Nitrogen content of upper 15 cm of soil - The percent of nitrogen contained in the upper 15 cm of soil. In the dominant and subdominant nitrogen content attributes, the following values are used to represent the various groupings:

Code	Description
0	<0.1%
1	0.1-0.5%
2	0.6-1.5%
3	>1.5%
#	Not applicable (water, rock, ice)
-	Attribute does not occur

Thickness of humus layer (L, F, H) - The thickness categories for the humus layer. In the dominant and subdominant thickness of humus layer attributes, the following values are used to represent the various groupings:

Code	Description
0	<5 cm
1	5-10 cm
2	11-20 cm
3	21-40 cm
4	>40 cm
#	Not applicable (e.g., cultivated, eroded)
-	Attribute does not occur

Calcareous class of parent material - The calcareous class of the parent material. In the dominant and subdominant calcareous class attributes, the following values are used to represent the various groupings:

Code	Description
0	Noncalcareous. No CaCO3 detectable with dilute HCl.
1	Weakly. 1-5% CaCO3 equivalents (weak effervescence with dilute HCl).
2	Strongly. 6-40% CaCO3 equivalents (moderate to strong effervescence with dilute HCl).
3	Extremely. >40% CaCO3 equivalents (very strong effervescence with dilute HCl).
#	Not applicable (water, rock, ice).
-	Attribute does not occur.

Inclusions 1 - The predominant type of inclusions found in the area. Inclusions may represent a maximum of 15% of the polygon area. Although their percent occupance is relatively small, they are generally strongly contrasting to the dominant or subdominant soil landscapes. A maximum of two inclusions may be recorded for each of the dominant and subdominant soil landscapes; a maximum of four inclusions may be recorded for each polygon. Inclusions provide an opportunity to document that "little bit" of extra information about the polygon. They may be associated with the dominant or subdominant soil landscape or they may occur independently. Extreme caution is recommended when using inclusions in area calculations. In the dominant and subdominant inclusions attributes, the following values are used to represent the various groupings:

Code	Description
A	Acid surface soil. pH <6.0.
BG	Bog. See attribute number 09, code B.
BL	Black Chernozemic soil. See attribute number 11, code C.
BC	Brown Chernozemic soil. See attribute number 11, code A.
BR	Bedrock, hard. Consolidated bedrock that is too hard either to break with the hands (>3 on Mohs' scale) or to dig with a spade when moist.
BS	Bedrock, soft. Bedrock that can be broken with the hands (<3 on Mohs' scale) and dug with a spade when moist.
C	Clay substrate. Clay material forming a lithologic discontinuity within 1 m of the soil surface.
CA	Calcareous surface soil. Indicated by visible effervescence when dilute HCl is added.
CC	Colluvium. See attribute number 09, code C.
CH	Chernozemic soil. Unspecified Chernozemic soils; more than one subgroup present.
CY	Clay. See attribute number 10.
D	Dissected surface form. See attribute number 07, code D.
DB	Dark Brown Chernozemic soil. See attribute number 11, code B.
DC	Deep colluvium. Colluvial material (see attribute number 09, code C) to a depth of >1 m.
DG	Deep gravelly fluvioglacial. Gravelly fluvioglacial material to a depth of >1 m; see attribute numbers 09 (code F) and 10.
DU	Duric material. See attribute number 15, code D.
E	Eroded knolls. Relatively light-colored knolls compared to other slope positions, occurring in hummocky or knoll-and-kettle surface forms.
EO	Eolian material. >50 cm of eolian material (see attribute number 09, code E).
ES	Eroded slopes. Slopes eroded by water.
F	Fluvioglacial substrate. Substrate of fluvioglacial material (see attribute number 09, code F).
FH	Ferro-Humic Podzolic soil. See attribute number 11, code V.
FO	Folisol. See attribute number 11, code 2.
G	Sandy loam morainal material. Morainal material with a sandy loam texture (see attribute number 10).
GG	Gravelly alluvium. See attribute numbers 09 (code A) and 10.
GG	Gravelly fluvioglacial material. See attribute numbers 09 (code F) and 10.
GL	Gleyed soil. Presence of faint to distinct mottles (or blotches) of different color interspersed within the dominant matrix color.
GM	Gravelly marine material. See attribute number 09 (code W) and 10.
GV	Orthic Gray Luvisolic soil. See attribute number 11, code F.
GY	Gleysolic soil. See attribute number 11, code U.
HC	Shallow lithic colluvium. Colluvial material (see attribute number 09, code C) overlying a lithic contact 50-100 cm from

	the surface.
HP	Humo-Ferric Podzolic soil. See attribute number 11, code W.
HU	Hummocky surface form. See attribute number 07, code H.
I	Brunisolic Gray Luvisolic soil. See attribute number 11, code I.
IC	Ice. See attribute number 03, code C.
ID	Imperfectly drained soil. See attribute number 17, code I.
L	Melanic Brunisolic soil. See attribute number 11, code L.
LC	Lacustrine material. See attribute number 09, code L.
LF	Loamy alluvium material. See attribute numbers 09 (code A) and 10.
LI	Lithic layer. Bedrock occurring within the normal depth of soil development, usually within 1 m of the soil surface.
LM	Loamy morainal till. Till (or morainal) material in which soil separates contain <35% clay and coarse fragments occupy <35% by volume.
LO	Loamy marine material. See attribute numbers 09 (code W) and 10.
LS	Silty lacustrine material. See attribute numbers 09 (code L) and 10.
LU	Luvisolic soil. See attribute number 11, code E or F.
M	Eutric Brunisolic soil. See attribute number 11, code M.
ML	Clay loam marine material. See attribute numbers 09 (code W) and 10.
MP	Moss peat. Relatively undecomposed, spongy organic material.
N	Sombric Brunisolic soil. See attribute number 11, code N.
NN	None.
O	Organic material. See attribute number 09, code O.
OC	Organic Cryosolic soil. See attribute number 11, code O.
OT	Ortstein. See attribute number 15, code O.
P	Dystric Brunisolic soil. See attribute number 11, code P.
PD	Poorly drained soil. See attribute number 17, code P.
PP	Poorly drained, peat soil. Poorly drained soil with a peaty surface layer (<40-cm thick).
R1	Soft rock outcrops. See attribute number 03, code R1.
R2	Hard rock outcrops, acidic. Granite rock outcrops.
R3	Hard rock outcrops, basic. Limestone rock outcrops.
R4	Hard rock outcrops, undifferentiated. See attribute number 03, code R4.
RD	Rapidly drained soil. See attribute number 17, code R.
RG	Regosolic soil. See attribute number 11, code R.
SA	Saline soil. Soil causing an obvious reduction in crop growth, may have white surface crust.
SC	Static Cryosolic soil. See attribute number 11, code S.
SD	Sandy marine material. Marine material with a sand texture class; see attribute numbers 09 (code A) and 10.
SF	Sandy alluvium. See attribute numbers 09 (code A) and 10.
SG	Sandy fluvioglacial material. Fluvioglacial material but with a sand texture class; see attribute numbers 09 (code F) and 10.
SH	Gravelly shoreline. See attribute number 10.
SL	Silty alluvium. See attribute numbers 09 (code A) and 10.
SO	Sombric Humo-Ferric Podzolic soil. See attribute number 11,

	code W.
SP	Steep surface form. See attribute number 07, code S.
SS	Silty surface texture. See attribute number 10.
ST	Stony surface. Sufficient stones to seriously handicap cultivation.
SY	Sandy material. See attribute number 10.
T	Till substrate. Till (or morainal) material forming a lithologic discontinuity within 1 m of the soil surface.
TA	Talus. Sloping mass of rock fragments below a cliff or at the foot of a steep slope.
TC	Turbic Cryosolic soil. See attribute number 11, code T.
TE	Terric layer. Unconsolidated mineral substratum occurring within the normal depth of organic soil development (40-160 cm).
TR	Terraced surface form. See attribute number 07, code T.
TT	Anthropogenic material. See attribute number 09, Code T.
VA	Volcanic ash. Deposition of fine, wind-transported material of volcanic origin deposited in thin layers that persist for a long time in bogs, river terraces, talus slopes, and kettle holes.
VS	Very shallow lithic layer. Rock material occurring at <50 cm from the surface.
WD	Well-drained soil. See attribute number 17, code W.
WE	Wind erosion. Removal of surface soil particles caused by wind action.
WT	Wetlands. Lands dominated by the persistent presence of excess water indicated by Gleysolic and shallow Organic soils under a cover of hydrophytic vegetation.
X	Fibrisol. See attribute number 11, code X.
Y	Mesisol. See attribute number 11, code Y.
Z	Humisol. See attribute number 11, code Z.
11	Fibric-sphagnum soil. Sphagnum organic soil in the stage of decomposition in which fibric materials are readily identifiable as to botanical origin.
14	Patterned ground. See attribute number 24.
17	Bouldery material. Rounded or irregular coarse fragments >60 cm in diameter.
21	Mesic-sedge material. Sedge organic material in a mesic (or intermediate) degree of decomposition.
23	Mesic-woody forest material. Woody-forest organic material in a mesic degree of decomposition; the material is partly altered physically and biochemically.
#	Not applicable.
-	Attribute does not occur.
22	(Not in original documentation.)

Inclusions 2 - The secondary type of inclusions found. In the dominant and subdominant inclusions attributes, the same values are used as for inclusions 1 described previously.

Vegetative cover or land use, or both - The category of vegetative cover or type of land use in the area. In the dominant and subdominant vegetative cover or land use attributes, the following values are used to represent the various groupings:

Code	Description
A	Agricultural crops. Annual field crops.
B	Bog. Bogs may be treed or treeless and are usually covered with Sphagnum spp. and ericaceous shrubs.
C	Coniferous forest. Dominated by needle-leaved, cone-bearing species.
D	Deciduous forest. Dominated by broadleaf species.
E	Fen. Dominated by sedges, grasses, reeds, and brown mosses with some shrubs and, at times, a sparse tree layer.
G	Grassland. Perennial native grassland or improved pasture.
H	Arctic desert. Unvegetated areas in the polar desert of the high Arctic; may be caused by either climatic (too cold or too dry) or edaphic (low soil nutrients or toxic substrate) factors, or a combination of both.
M	Mixed deciduous and coniferous forest. See codes C and D.
P	Parkland. A forest-grassland transition comprising a mosaic of trembling aspen stands interspersed with patches of cropland, grassland, and meadow.
R	Marshland. A mosaic surface pattern composed of pools or channels interspersed with clumps of emergent sedges, grasses, rushes, and reeds, bordering grassy meadows, and peripheral bands of shrubs or trees; submerged and floating aquatics flourish in open water areas.
S	Shrubland. Dominated by shrub species.
SP	Sedge peat. Dominated by Carex spp. and generally moderately decomposed and matted; the sedge leaves are readily identifiable to the naked eye.
TA	Tundra, alpine. Treeless terrain found at high altitudes occurring immediately above the forest zone and the upper altitudinal timberline; tundra vegetation comprises lichens, mosses, sedges, grasses, forbs, and low shrubs (<20 cm). including heaths, dwarf willows, and birches.
TL	Tundra, low shrub. Treeless terrain found at high latitudes occurring most widely in the zone immediately north of the boreal forest, including the treeless parts of the forest-tundra ecotone adjacent to the treeline; tundra vegetation comprises lichens, mosses, sedges, grasses, forbs, and low shrubs (<20 cm), including heaths, dwarf willows, and birches.
TM	Tundra, medium shrub. Similar to low-shrub tundra (see code TL) except for medium (>20 cm) instead of low shrubs.
U	Unvegetated surface.
#	Not applicable.
-	Attribute does not occur.

Lake size estimated from Landsat imagery - The size category of a lake that exists over the area. In the dominant and subdominant lake size attributes, the following values are used to represent the various groupings:

Code	Description
S	Small. <1 km^2 (not visible on 1:1,000,000 scale Landsat imagery).
M	Medium. 1-10 km^2.
L	Large. 11-50 km^2.
V	Very large. >50 km^2.
#	Not applicable.
-	Attribute does not occur.
F	(Not in original documentation.)

The percent levels of the area covered by water bodies that are wholly contained within the polygon as estimated from Landsat images. In the dominant and subdominant percent water body attributes, the following values are used to represent the various groupings:

Code	Description
F	Few. Water bodies cover 0-10% area of polygon.
C	Common. Water bodies cover 11-25% area of polygon.
M	Many. Water bodies cover 26-50% area of polygon.
A	Abundant. Water bodies cover >50% area of polygon.
#	Not applicable.
-	Attribute does not occur.

Reliability class of polygon - The relative reliability of the information provided for the polygon. In the dominant and subdominant reliability class attributes, the following values are used to represent the various groupings:

Code	Description
V	Very low. Compiled from interpretation of Landsat data only; no ground data are collected for verification of these areas.
L	Low. Compiled from soil survey maps produced from field traverses at wide intervals (up to 10 km) and without the use of aerial photographs or compiled from maps produced by inspections using fixed-wing aircraft or helicopter and aided by interpretation of Landsat imagery.
M	Medium. Produced from systematic traverses by helicopter and by interpretation of stereoscopic aerial photograph or compiled from modern soil survey procedures, including traversing existing accessible roads in wilderness areas, and aided by interpretation of stereoscopic aerial photographs.
H	High. Compiled from modern soil survey maps produced from field traverses at <1.6-km intervals and with the aid of stereoscopic aerial photographs.
#	Not applicable.
-	Attribute does not occur.

Complexity class of polygon - The relative complexity or variability of the soil in the area. In the dominant and subdominant complexity class attributes, the following values are used to represent the various groupings:

Code	Description
L	Low. Soil and landscape attributes within the polygon are uniform for most interpretations; in most cases the polygon has only a dominant component.
M	Medium. Soil and landscape attributes are moderately variable but predictable; there are generally dominant and subdominant components, each of which usually has been generalized from no more than two classes of parent material or soil development, or both; there may also be an inclusion in the polygon.
H	High. Soil and landscape attributes are highly variable and unpredictable; dominant, subdominant, and inclusion components are present, each of which has been generalized from more than two classes of parent material or soil development, or both; use this class to warn of extreme oversimplification in any interpretations from the extended legend.
#	Not applicable.
-	Attribute does not occur.

Soil name - The dominant and subdominant soil name.

Parent material textural group - The texture group of the parent material. In the dominant and subdominant parent material texture attributes, the following values are used to represent the various groupings:

Code	Description
sd	Sand. Group includes CBS, CBLS, CS, S, LS, LFS, FS, GS, VGS, LVFS, VS, GLS, and VGLS.
sl	Sandy loam. Group includes CBSL, SL, FL, GSL, VGSL, and GFL.
lm	Loam. Group includes GL, CBL, L, GSIL, VL, and SIL.
cl	Clay loam. Group includes CBCL. GSCL, GCL, SCL, VCL, CL, and SICL.
cy	Clay. Group includes SC, GSIC, SIC, C, and HC.
#	Not applicable.
-	Attribute does not occur.

Area of Polygon - The area of the polygon in kilohectares to one decimal place.

7.3.3 Unit of Measurement

Provincial Code - Unitless but coded value.
Polygon Number - Unitless but coded value.
Surface material - Unitless but coded value.
Percentage distribution of dominant and subdominant soil landscapes - Percent.
Grid code for locating polygons - Unitless but coded value.
Regional landform - Unitless but coded value.
Local surface form - Unitless but coded value.
Slope gradient class - Unitless but coded value.
Soil parent material mode of deposition (or origin) - Unitless but coded value.
Parent material texture - Unitless but coded value.
Soil development - Unitless but coded value.
Surface texture of mineral soil to 15 cm - Unitless but coded value.

Coarse fragment content of mineral soils - Unitless but coded value.
Rooting depth, unrestricted - Unitless but coded value.
Kind of compacted, consolidated, or contrasting layer - None.
Depth to compacted, consolidated, or contrasting layer - None.
Drainage class - Unitless but coded value.
Available water capacity in upper 120 cm - Unitless but coded value.
Average depth to water table - Unitless but coded value.
Ice type - Unitless but coded value.
Ice content - Unitless but coded value.
Permafrost occurrence - Unitless but coded value.
Active layer depth in soils with permafrost - Centimeters.
Kind of patterned ground in soils with permafrost - Unitless but coded value.
pH of upper 15 cm of soil measured in $CaCl_2$ - Tenths of pH units. Divide by 10.
pH of upper 15 cm of soil measured in water - Tenths of pH units. Divide by 10.
Organic carbon of upper 15 cm of soil - Percent.
Nitrogen content of upper 15 cm of soil - Unitless but coded value.
Thickness of humus layer (L, F, H) - Unitless but coded value.
Calcareous class of parent material - Unitless but coded value.
Inclusions 1 - Unitless but coded value.
Inclusions 2 - Unitless but coded value.
Vegetative cover or land use, or both - Unitless but coded value.
Lake size estimated from Landsat imagery - Unitless but coded value.
Reliability class of polygon - Unitless but coded value.
Complexity class of polygon - Unitless but coded value.
Soil name 1 - Unitless but coded value.
Soil name 2 - Unitless but coded value.
Parent material textural group - Unitless but coded value.
Area of polygon - Kilohectares.

7.3.4 Data Source

The original vector data set was produced by Agriculture Canada and was acquired from:

CanSIS Project Leader
Land Resource Research Centre
Research Branch, Agriculture Canada
Central Experiment Farm
K.W. Neatby Building
Ottawa, Ontario, Canada K1A 0C6

7.3.5 Data Range

The various data layers have different data ranges. Some of the potential values are listed under the variable descriptions provided in Section 7.3.2.

7.4 Sample Data Record

Not applicable for these types of data files.

8. Data Organization

8.1 Data Granularity

The smallest amount of obtainable data is the entire data set containing all of the vector layers and their supporting files.

8.2 Data Format(s)

8.2.1 Uncompressed Data Files

The regional soils product contains 10 total files containing American Standard Code for Information Interchange (ASCII) information.

The first file is the ARC/INFO EXPORT file for the Saskatchewan data set. This file contains the soil polygon boundaries. The second file contains the Canada Soil Information System (CanSIS) documentation for the data. The third file contains information about the projection parameters. The fourth file is an ARC/INFO EXPORT file containing the INFO dominant attribute table for the polygons. The fifth file is an ARC/INFO EXPORT file containing the INFO subdominant attribute table for the polygons.

Files 6 through 10 contain the same type of information, respectively, for the Manitoba data set.

When reading the data from tape, the records should be organized in logical record lengths of 80 bytes each. The data are written to tape in 8,000- or 3,280-byte records to save time and space in writing to and reading from the tape media.

File	Description
1	ARC/INFO EXPORT of polygon coverage of Saskatchewan
2	CanSIS documentation file for the Saskatchewan data
3	Projection parameters for the Saskatchewan data
4	ARC/INFO EXPORT file of INFO table with dominant soil attributes for Saskatchewan data
5	ARC/INFO EXPORT file of INFO table with subdominant soil attributes for Saskatchewan data
6	ARC/INFO EXPORT of polygon coverage of Manitoba
7	CanSIS documentation file for the Manitoba data
8	Projection parameters for the Manitoba data
9	ARC/INFO EXPORT file of INFO table with dominant soil attributes for Manitoba data
10	ARC/INFO EXPORT file of INFO table with subdominant soil attributes for Manitoba data

File Number	Max. Record size (bytes)	Number of Records
1	8000	1694
2	8000	5
3	3280	1
4	8000	38
5	8000	38
6	8000	789
7	8000	5
8	3280	1
9	8000	17
10	8000	17

Before importing the files into ARC/INFO, the names of the files should include the .e00 extension since the ARC/INFO IMPORT command expects file names to have this extension.

8.2.2 Compressed CD-ROM Files

On the BOREAS CD-ROMs, files 1 through 10 have been compressed with the Gzip compression program (file name *.gz). These data have been compressed using gzip version 1.2.4 and the high compression (-9) option (Copyright (C) 1992-1993 Jean-loup Gailly). Gzip (GNU zip) uses the Lempel-Ziv algorithm (Welch, 1994) used in the zip and PKZIP programs. The compressed files may be uncompressed using gzip (-d option) or gunzip. Gzip is available from many Web sites (for example, ftp site prep.ai.mit.edu/pub/gnu/gzip-*.*) for a variety of operating systems in both executable and source code form. Versions of the decompression software for various systems are included on the CD-ROMs.

Note that after they are uncompressed, the names of the files should include the .e00 extension since the ARC/INFO IMPORT command expects file names to have this extension.

9. Data Manipulations

9.1 Formulae

No changes were made to the data as they were delivered to BORIS.

9.1.1 Derivation Techniques and Algorithms

None.

9.2 Data Processing Sequence

9.2.1 Processing Steps

BORIS staff copied and compressed the files for release on CD-ROM.

9.2.2 Processing Changes

None.

9.3 Calculations

9.3.1 Special Corrections/Adjustments

None.

9.3.2 Calculated Variables

None.

9.4 Graphs and Plots

None.

10. Errors

10.1 Sources of Error

Potential sources of error in the original data set could be interpretation or digitizing error. There is also the possibility of coding and keying errors in the attributes.

10.2 Quality Assessment

10.2.1 Data Validation by Source

The data were visually inspected to ensure that they were the data indicated in the original documentation.

10.2.2 Confidence Level/Accuracy Judgment

The source in Canada from whom these data were received has strong caveats about the use of the data. These data are constantly being updated as new data are collected and become available. These data represent broad generalizations about the soil characteristics of this area. Caution is to be used when inferring information from these data.

10.2.3 Measurement Error for Parameters

Unknown.

10.2.4 Additional Quality Assessments

Unknown.

10.2.5 Data Verification by Data Center

As noted previously, BORIS personnel reviewed the data layers visually as vector plots. Direct quantitative checking of the data was not performed.

11. Notes

11.1 Limitations of the Data

The original data were received in two parts: Saskatchewan and Manitoba. Unfortunately, many of the attributes along the border have different values. Therefore, a sharp discontinuity exists along the border in many of the files, a result of different interpretations by those who created the maps for the different provinces. CanSIS has future plans to resolve these problem areas along the provincial boundaries.

11.2 Known Problems with the Data

The discontinuity of polygons along the provincial boundary could be a potential problem for some users. See Section 11.1 for more information on this problem.

11.3 Usage Guidance

Before uncompressing the Gzip files on CD-ROM, be sure that you have enough disk space to hold the uncompressed data files. Then use the appropriate decompression program provided on the CD-ROM for your specific system. Also note that after they are uncompressed, the names of the files should include the .e00 extension since the ARC/INFO IMPORT command expects file names to have this extension.

11.4 Other Relevant Information

None.

12. Application of the Data Set

The documentation for the original data listed the following uses for which these data were intended:

- Assess the productivity of the land nationally or over large regions.
- Find areas that have actual or potential problems affecting land use, such as salinity or susceptibility to erosion, and assess the severity of the problems.
- Locate general areas that may be suitable for particular types of land use that can be selected for more detailed investigations.

- Apply general research findings and agrotechnology procedures that are successful in one part of the country to other areas that have similar attributes.
- Link soil and land information with other data bases, such as information on climate, economics, or census, for assessing land use on a regional, national, or even an international scale.
- Educate geography students at colleges or universities.

13. Future Modifications and Plans

CanSIS has future plans to resolve these problem areas along the provincial boundaries.

14. Software

14.1 Software Description

BORIS staff used the ARC/INFO (Version 7) software and related tools to import and visually inspect the data. The ARC/INFO software is a proprietary package developed and distributed by:

Environmental Systems Research Institute, Inc.
380 New York St.
Redlands, CA 92373-8100

Gzip (GNU zip) uses the Lempel-Ziv algorithm (Welch, 1994) used in the zip and PKZIP commands.

14.2 Software Access

ARC/INFO is a commercial package; contact ESRI for details. Gzip is available from many Web sites across the Internet (for example, ftp site prep.ai.mit.edu/pub/gnu/gzip-*.*) for a variety of operating systems in both executable and source code form. Versions of the decompression software for various systems are included on the CD-ROMs.

15. Data Access

The CanSIS regional soils data in vector format are available from the Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

15.1 Contact Information

For BOREAS data and documentation please contact:

ORNL DAAC User Services
Oak Ridge National Laboratory
P.O. Box 2008 MS-6407
Oak Ridge, TN 37831-6407
Phone: (423) 241-3952
Fax: (423) 574-4665
E-mail: ornldaac@ornl.gov or ornl@eos.nasa.gov

15.2 Data Center Identification

Earth Observing System Data and Information System (EOSDIS) Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC) for Biogeochemical Dynamics
http://www-eosdis.ornl.gov/.

15.3 Procedures for Obtaining Data

Based on agreements made with Agriculture Canada, these data are available only to individuals and groups that have an official relationship with the BOREAS project. A raster version of this data set titled 'BOREAS Regional Soils Data in Raster Format and AEAC Projection' is publicly available and is included on the BOREAS CD-ROM set.

Users may obtain data directly through the ORNL DAAC online search and order system [http://www-eosdis.ornl.gov/] and the anonymous FTP site [ftp://www-eosdis.ornl.gov/data/] or by contacting User Services by electronic mail, telephone, fax, letter, or personal visit using the contact information in Section 15.1.

15.4 Data Center Status/Plans

The ORNL DAAC is the primary source for BOREAS field measurement, image, GIS, and hardcopy data products. The BOREAS CD-ROM and data referenced or listed in inventories on the CD-ROM are available from the ORNL DAAC.

16. Output Products and Availability

16.1 Tape Products

These data can be made available on 8-mm, Digital Archive Tape (DAT), or 9-track tapes at 1600 or 6250 Bytes Per Inch (BPI).

16.2 Film Products

None.

16.3 Other Products

These data are available on the BOREAS CD-ROM series.

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17.3 Archive/DBMS Usage Documentation

None.

18. Glossary of Terms

None.

19. List of Acronyms

```
AEAC    - Albers Equal-Area Conic
ASCII   - American Standard Code for Information Interchange
BOREAS  - BOReal Ecosystem-Atmosphere Study
BORIS   - BOREAS Information System
BPI     - Bytes Per Inch
CanSIS  - Canada Soil Information System
CCRS    - Canadian Centre for Remote Sensing
CCT     - Computer Compatible Tape
CD-ROM  - Compact Disk-Read-Only Memory
DAAC    - Distributed Active Archive Center
DAT     - Digital Archive Tape
EOS     - Earth Observing System
EOSDIS  - EOS Data and Information System
ESRI    - Environmental Systems Research Institute, Inc.
GIS     - Geographic Information System
GSFC    - Goddard Space Flight Center
LCC     - Lambert Conformal Conic
LRRC    - Land Resource Research Centre
MSS     - Multispectral Scanner
NAD27   - North American Datum of 1927
NASA    - National Aeronautics and Space Administration
NSA     - Northern Study Area
ORNL    - Oak Ridge National Laboratory
PANP    - Prince Albert National Park
SSA     - Southern Study Area
TM      - Thematic Mapper
URL     - Uniform Resource Locator
UTM     - Universal Transverse Mercator
```

20. Document Information

20.1 Document Revision Date(s)

Written: 02-Dec-1994
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20.2 Document Review Date(s)

BORIS Review: 05-Jun-1997
Science Review:

20.3 Document ID

20.4 Citation

When using these data, please include the following acknowledgment as well as citations of relevant papers in Section 17.2:

The original data were provided by Agriculture Canada. The contribution of the vector data by Agriculture Canada is greatly appreciated.

If using data from the BOREAS CD-ROM series, also reference the data as:

BOREAS Staff Science, "BOREAS Staff Science GIS Data Collection Program." In Collected Data of The Boreal Ecosystem-Atmosphere Study. Eds. J. Newcomer, D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers. CD-ROM. NASA, 2000.

Also, cite the BOREAS CD-ROM set as:

Newcomer, J., D. Landis, S. Conrad, S. Curd, K. Huemmrich, D. Knapp, A. Morrell, J. Nickeson, A. Papagno, D. Rinker, R. Strub, T. Twine, F. Hall, and P. Sellers, eds. Collected Data of The Boreal Ecosystem-Atmosphere Study. NASA. CD-ROM. NASA, 2000.

20.5 Document Curator

20.6 Document URL

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13. ABSTRACT *(Maximum 200 words)*

This data set is the original vector data set received from CanSIS. The data include the provinces of Saskatchewan and Manitoba. Attribute tables provide the various soil data for the polygons; there is one attribute table for Saskatchewan and one for Manitoba. The data are stored in ARC/INFO export format files. Based on agreements made with Agriculture Canada, these data are available only to individuals and groups that have an official relationship with the BOREAS project. These data are not included on the BOREAS CD-ROM set. A raster version of this data set titled 'BOREAS Regional Soils Data in Raster Format and AEAC Projection' is publicly available and is included on the BOREAS CD-ROM set. See Section 15 for current details on data availability.

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